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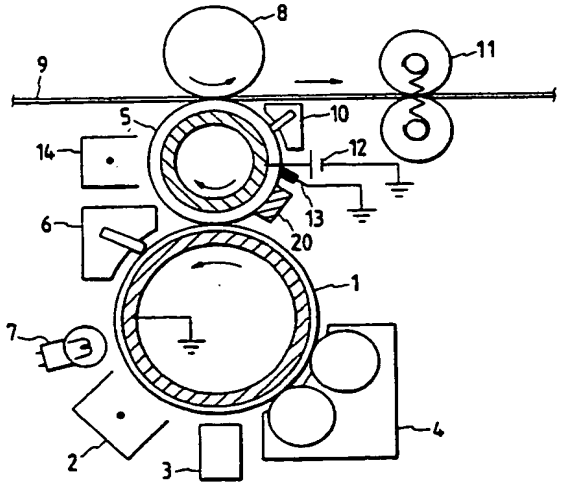
(54) Wet type image forming apparatus.

(57) A wet type image forming apparatus comprises: a photo-sensitive drum (1) on which a latent image is formed and developed into a toner image with liquid-phase toner; an intermediate transferring medium (5) onto which the toner image is transferred; a pressurizing roll (8) which abuts a recording sheet (9) against the intermediate transferring medium (5) to transfer the toner image onto the recording sheet; means for reducing the potential of the toner image transferred onto the intermediate transferring medium; and means (20) for applying a mold releasing agent to the intermediate transferring medium (5) before the toner image is transferred from the image bearer (1) onto the intermediate transferring medium (5), whereby an image high in picture quality can be printed on a recording sheet (9) independently of the smoothness of the recording sheet, and transferring of the toner image can be achieved with low transferring voltage.

FIG. 10



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WET TYPE IMAGE FORMING APPARATUS

This invention relates to a wet type image forming apparatus. In a wet type image forming apparatus an electrostatic latent image formed on an electrostatic latent image bearer is developed with liquid toner, and transferred onto a recording medium such as a recording sheet, to form an image. The liquid toner means a liquid toner including electrified toner particles containing pigment which are dispersed in an insulation solvent.

In a conventional wet type image forming apparatus, its latent image bearer is made up of a metal drum, and a latent image bearing layer formed on the metal drum. A latent image formed on the latent image bearer is developed into a toner image, which is then transferred onto a recording sheet while being brought into contact with the latter. (cf. Electrophotographic Society Publication "Transition and Tendency of the Wet type Copying Machine", 26, 3 (1987), pp 270 - 276).

The conventional wet type image forming apparatus is still disadvantageous in the following points: With the apparatus, even if the latent image is developed into a toner image with high fidelity, the toner image is not satisfactorily transferred onto a recording sheet if the latter is low in smoothness. In other words, if the recording sheet has an uneven surface, in a transfer process, some of the toner forming the toner image is not brought into contact with the recording sheet, as a result of which the image printed on the recording sheet is low in picture quality. Furthermore, the toner image developed on the electrostatic latent image bearer is wet containing a solvent component in addition to the toner. Therefore, when the toner image is brought into contact with the recording sheet, the solvent may spread thus collapsing the image. In addition, the apparatus needs a high voltage power source providing a voltage of several kilo-volts to transfer a toner image from a toner bearer to the recording sheet.

Accordingly, an object of this invention is to eliminate the above-described difficulties accompanying a conventional wet type image forming apparatus.

More specifically, an object of the invention is to provide a wet type image forming apparatus which can form an image high in picture quality on a recording sheet independently of the smooth of the latter, and transferring a toner image can be achieved with a relatively low transferring voltage.

These objects are solved by the wet type image forming apparatus according to claim 1. Further advantageous features of the apparatus are evident from the dependent claims.

The foregoing object and other objects of the invention have been achieved by the provision a wet type image forming apparatus in which an electrostatic latent image formed on an image bearer is developed with liquid toner, and is then transferred onto a recording medium, which, according to the invention, comprises: first toner image transferring means for electrostatically transferring a toner image developed on the image bearer onto an intermediate transferring medium; and second toner image transferring means for abutting a recording sheet against the intermediate transferring medium to transfer the toner image from the intermediate transferring medium onto the recording sheet.

In the apparatus, the intermediate transferring medium is made up of an elastic layer which comprises a dielectric layer with a smooth surface to which a toner image is borne.

In the apparatus, the intermediate transferring medium has an elastic layer which is able to absorb the solvent of a liquid toner, and a pressurizing roll is provided to bring the toner image formed on the intermediate transferring medium into contact with the recording sheet.

Furthermore in the apparatus comprising: the image bearer on which a latent image is developed into a toner image with liquid-phase toner; the intermediate transferring medium onto which the toner image is transferred; and the pressurizing roll which abuts a recording sheet against the intermediate transferring medium to transfer the toner image onto the recording sheet, which further comprises: means for reducing the potential of the toner image transferred onto the intermediate transferring medium; and means for applying a mold releasing agent to the intermediate transferring medium before the toner image is transferred from the image bearer onto the intermediate transferring medium.

The nature, principle and utility of the invention will become more apparent from the following detailed description and the appended claimed when read in conjunction with the accompanying drawings in which like parts are designated by like reference numerals or characters.

In the accompanying drawings:

Fig. 1 is an explanatory diagram showing the arrangement of a printer, according to this invention;

Fig. 2 is a sectional view showing an intermediate transferring drum of the invention;

Fig. 3 is a perspective view showing an intermediate transferring drum of the invention;

Fig. 4 is an explanatory diagram showing the arrangement of a printer, according to the inven-

tion;

Fig. 5 is an explanatory diagram showing a transferring region in the printer;

Fig. 6 is a perspective view, with parts sections, showing another example of the intermediate transferring drum;

Fig. 7 is a perspective view, with parts cut away, showing a pressurizing roll employed in a printer, according to this invention;

Fig. 8 is a sectional view showing the arrangement of a printer, according to the invention;

Fig. 9 is an explanatory diagram for a description of the reduction of the potential of a toner image in the printer according to the invention; and

Fig. 10 is a sectional view showing the arrangement of a printer, according to the invention.

Preferred embodiments of this invention will be described with reference to the accompanying drawings.

An electrophotographic printer, a first embodiment of this invention, is as shown in Fig. 1. In the printer, a recording sheet 9 is supplied from a sheet supplying unit 101 and conveyed to a transferring position while being synchronized with the rotations of a photo-sensitive drum 1 which acts as an image bearer and an intermediate transferring drum 5 by timing rollers 102. A charging unit 2, an exposing unit 3 (or a laser scanner in the embodiment), a developing unit 4, the intermediate transferring drum 5, a cleaning unit 6, and a discharging unit 7 are arranged around the photo-sensitive drum 1. The recording sheet on which a toner image has been transferred is delivered by a conveying belt 112 to a stacker 111 through a fixing unit 11.

In the printer thus constructed, a developing operation is carried out with a liquid toner which is prepared by dispersing charged resin in an insulating carrier liquid solvent; that is, a wet type developing operation is carried out. The liquid toner in the developing unit 4 is applied to the photo-sensitive drum with developing rollers 41, and excess liquid toner is removed from the drum with a squeezing roller 42. The photo-sensitive drum 1 is formed by providing a photo-sensitive layer on an aluminum pipe.

In the printer, an image transferring operation is carried out as follows: A potential difference is provided between the intermediate transferring drum 5 and the aluminum pipe of the photo- sensitive drum 1, so that a toner image on the photo-sensitive drum is transferred onto the intermediate transferring drum through electrostatic field. Since the intermediate transferring drum has a smooth cylindrical wall, the toner image is transferred from the photo-sensitive drum onto the intermediate transferring drum with high fidelity. In this operation, because a pressure applied between the intermediate transferring drum and the photo-sensitive drum may be small, the photo-sensitive drum is preventable from being degraded.

Thereafter, the recording sheet 9 is abutted against the intermediate transferring drum 5, and is then pushed against it by a pressurizing roller 8, so that the toner image is transferred onto the recording sheet.

The concrete construction of the intermediate transferring drums according to the present invention will be explained in detail.

Fig. 3 shows an intermediate transferring drum employed in the first embodiment of the invention.

The intermediate transferring drum 5, as shown in Fig. 3, comprises: a hollow metal drum 50; and a conductive elastic layer 51 formed on the outer wall of the metal drum 50.

In transferring the toner image from the photo-sensitive drum 1 to the intermediate transferring drum 5 (hereinafter referred to as "a primary toner image transferring operation", when applicable), a potential difference is provided between the metal base of the photo-sensitive drum and the hollow metal drum of the intermediate transferring drum to form a transferring field between the elastic layer 51 and the toner image on the photo-sensitive drum 1 thereby to transfer the toner image onto the intermediate transferring drum 5 in an electrostatic mode.

In this case, the elastic layer 51 of the intermediate transferring drum 5 being smooth, the toner image on the photo-sensitive drum 1 is, in its entirety, brought into contact with the intermediate transferring drum. Therefore, the primary toner image transferring operation is free from the conventional difficulty that transferring the toner image is not completely achieved because a part of toner forming the toner image cannot come into contact with the transferring medium due to the unevenness of the transferring medium.

In transferring the toner image from the intermediate transferring drum 5 onto the recording sheet 9 (hereinafter referred to as "a secondary toner image transferring operation", when applicable), the pressurizing roll 8 is pushed against the intermediate transferring drum 5 through the recording sheet 9, as a result of which the elastic layer 51 is deformed according to the irregularity of the surface of the recording sheet 9. Then, all the toner forming the toner image borne to the intermediate transferring drum can put in close contact with the uneven surface of the recording sheet. Therefore, the toner image is mechanically transferred onto the recording sheet 9 with high fidelity independently of the smoothness of the recording sheet 9. In order to facilitate the secondary toner image transferring operation, the elastic layer 51 of the intermediate transferring drum 5 is made of a

material excellent in mold releasing characteristic.

As the pressurizing roll 8 is abutted against the intermediate transferring drum 5, it is unnecessary to drive the pressurizing roll 8; that is, the pressurizing roll 8 is turned with no slip with the intermediate transferring drum 5. Accordingly, the recording sheet 9, while being held between the pressurizing roll 8 and the intermediate transferring drum 5, is conveyed with no slip with the intermediate transferring drum 5. This will prevent the occurrence of a difficulty that, when transferred, the image is lowered in quality because of the irregular conveyance of a recording sheet such as the jittering of a recording sheet.

A potential difference may be provided between the pressurizing roll 8 and the intermediate transferring drum 5; that is, also in the secondary toner image transferring operation, electrostatic energy may be additionally utilized.

Fig. 5 is an explanatory diagram showing a primary toner image transferring region. In this case, a transferring field E is as follows:

$$E = \{(V_H - V_P)/\epsilon_s\}/(d_o/\epsilon_o + d_t/\epsilon_t + d_m/\epsilon_m + g/\epsilon_s) \quad (1)$$

where V_H is the surface potential of the toner layer, V_P is the transferring voltage applied to the metal base of the intermediate transferring drum, d_o/ϵ_o is the effective dielectric thickness of the transferring medium, or the effective dielectric thickness of the elastic layer of the intermediate transferring drum, d_m and ϵ_m are the thickness and dielectric constant of the photo-sensitive layer of the photo-sensitive drum, respective, d_t and ϵ_t are the thickness and dielectric constant of the toner layer on the photo-sensitive drum, respectively, g is the gap between the toner layer and the elastic layer, and ϵ_s is the dielectric constant of the solvent of liquid toner.

In order to perform the primary toner image transferring operation satisfactorily, it is necessary to give a high transferring field. In the invention, liquid-phase toner is employed. Therefore, d_t/ϵ_t and g/ϵ_s are about 1μm, and are smaller than d_m/ϵ_m which is about 7μm, thus less affecting the transferring filed E of Equation (1). The degree of freedom of setting $d_m\epsilon_m$ is not so large because of the charging, photo-sensitive and developing characteristics of the photo-sensitive drum. Therefore, the transferring field E of Equation (1) depends greatly on the effective dielectric thickness d_o/ϵ_o. That is, in order to obtain a high transferring field with a low transferring voltage, it is essential to reduce the effective dielectric thickness d_o/ϵ_o.

In the secondary toner image transferring operation, the elastic function of the elastic layer 51 is utilized to bring the intermediate transferring drum 5 into close contact with the recording sheet 9. In this case, the elastic layer 51 should be relatively large in thickness because, if the thickness of the elastic layer 51 is small, its sufficient elastic effect cannot be expected. That is, the elastic layer should be 0.5 to 2.5 mm in thickness for a sufficient elastic effect.

As was described above, it is desired in the primary toner image transferring operation that the effective dielectric thickness of the elastic layer 51 is small, whereas it is desired in the secondary toner image transferring operation that the thickness of the elastic layer 51 is large. More specifically, it is desired that the elastic layer 51 is 0.5 to 1.5 mm in thickness, and yet the effective dielectric thickness is reduced. In this case where the elastic layer 51 made of the electrically conductive rubber with good unsticking property is employed, the elastic layer 51 is zero (0) in effective dielectric thickness, and therefore a high transferring field can be obtained in the primary toner image transferring operation, and the elastic layer 51 bearing the toner image can be brought into close contact with the recoding sheet 9 in the secondary toner image transferring operation.

Fig. 2 shows a sectional view of another intermediate transferring drum used in the present invention.

The intermediate transferring drum comprises a hollow metal drum 50 and an elastic layer 51 provided on the outer periphery of the metal drum 50. The elastic layer 51 comprises a rubber layer 54 and an electrically conductive layer 53 supported by the rubber layer 54. The electrically conductive layer 53 may be formed according to a method in which a resin layer containing electrically conductive compound is formed on a rubber layer, or a thin metal layer is formed on a rubber layer by plating or vacuum deposition.

With the above construction, a good toner image can be formed on a recording sheet, similarly to the intermediate transferring drum.

Fig. 4 shows an electrophotographic printer according to a second embodiment of the invention. In the figure, the embodiment is different from the first embodiment in that there is provided a discharge unit 13 composed, for example, of a conductive brush. The toner image formed on the photosensitive drum is first transferred onto an intermediate transferring drum, and thereafter the toner image thus transferred onto the intermediate transferring drum is secondly transferred onto a recording sheet, while the recording sheet is abutted against the intermediate transferring drum. This printing operation is the same as that of the first embodiment.

The intermediate transferring drum 5 used in this embodiment has a double-layer structure so that, even in the case where a pin hole defect occurs in the photosensitive drum, as shown in Fig. 6, a transferring electric field can be formed at the

first transferring step. That is, the elastic layer 51 is made up of a surface layer, or dielectric layer 52,5 to 30 μm to thickness, and a base layer, or electrically conductive rubber layer 53 much larger in thickness than the dielectric layer 52. In the dual layer structure, the effective dielectric thickness of the elastic layer 51 is determined by the effective dielectric thickness of the thin dielectric layer 52. Therefore, similarly as in the above-described case, a high transferring field can be obtained in the primary toner image transferring operation, and the elastic layer 51 bearing the toner image can be brought into close contact with the recording sheet 9; that is, the requirements in the primary and secondary toner image transferring operations can be satisfied. For instance, the elastic layer 51 is made up of an electrically conductive rubber layer and a thin insulating layer formed on the rubber layer with the mold release of the elastic layer surface taken into account.

The discharging unit 13 shown in Fig. 4 removes electric charge on the dielectric layer 52 of the intermediate transferring drum 5, so that the first transferring operation is carried out under the electrostatically stable condition.

As for a concrete example of the above-described image forming apparatus, an elastic layer 51 was fabricated by forming an insulating layer 10 μ on an electrically conductive rubber layer 1 mm in thickness and $10^3\Omega$ cm. And when a transferring voltage 500V was applied to the metal base of the intermediate transferring drum, the toner image developed on the photo- sensitive drum was satisfactorily transferred onto the elastic layer 51 of the intermediate transferring drum. The elastic layer 51 was brought into close contact with the recording sheet 9, so that the toner image was satisfactorily transferred onto the latter 9 owing to the excellent mold release characteristic of the surface of the elastic layer 51.

In another concrete example, an elastic layer 51 was fabricated by forming a dielectric layer 20 μm, 3 in dielectric constant and $10^{15}\Omega$ cm in volume resistivity on an electrically conductive rubber layer 0.7 mm, $10^9\Omega$ cm in volume resistivity and 12 in dielectric constant, and a transferring voltage 500V was applied to the metal base of the intermediate transferring drum. In this case also, the toner image developed on the photo-sensitive drum was satisfactorily transferred on the intermediate transferring drum. It is preferable that the electrically conductive rubber layer is lower in resistance; however, under the above-described conditions, voltage drop was scarcely caused between electrically conductive rubber layers; that is, transferring voltage was applied substantially directly to the dielectric layer, so that the resultant transferring field was sufficiency high and transferring the toner image was satisfactorily achieved.

The toner image formed on the photosensitive drum is wet because of inclusion of a little solvent component. For that reason, in order to prevent the deformation of the toner image, which occurs when the photosensitive drum is abutted against the intermediate transferring drum by an excess force at the first transferring operation, a pressure applied between the photosensitive drum and the intermediate transferring drum is restrained to an allowable minimum.

The elastic layer of the intermediate transferring drum as described in the first and second embodiments may be made of material which absorbs the solvent component contained in the liquid toner so that the degree of the allowable pressure applied between the photosensitive drum and the intermediate transferring drum can be increased. Silicone may be selected as the material having the above-mentioned property. Accordingly, as the elastic layer of the intermediate transferring drum used in the first embodiment as described above, an electrically conductive silicone rubber may be used, whereas in the second embodiment, a silicone coat or a silicone rubber may be used as at least the dielectric layer of the elastic layer, so that the degree of the allowable pressure applied between the photosensitive drum and the intermediate transferring drum can be increased. In the second embodiment, the conductive layer also may be more preferably made of an electrically conductive silicone rubber.

Further, because the silicone rubber and silicone per se have a good unsticking propertiy, not only the degree of the allowable pressure is increased at the time of the secondary transferring operation, but also the secondary transferring operation is easily achieved under a low pressure.

In the conventional method in which the intermediate transferring medium being not used, the toner image is electrostatically transferred from the electrostatic latent image bearer directly onto the recording sheet, the image transferring characteristic is unstable because the resistance of the recording sheet is changed by atmospheric conditions such as for temperature and humidity. On the other hand, in the image forming apparatus of the invention, in the primary toner image transferring operation utilizing an electrostatic toner image transferring technique, the electrostatic toner image transferring operation is carried out stably because the electrical characteristic of the intermediate transferring medium, namely, the intermediate transferring drum 5 is not affected by such atmospheric conditions. In the primary toner image transferring operation, the recording sheet is not used; that is, the toner image is transferred from the photo-sensitive drum onto the elastic layer 51

of the thin dielectric layer 52 of the order of 5 to 30 μm in thickness, and therefore a sufficiently high transferring field can be formed with a low transferring voltage. In the secondary toner image transferring operation, the mechanical force applied through the recording sheet to the intermediate transferring drum 5 by the pressurizing roll 8, and the mold release characteristic of the surface of the intermediate transferring drum 51 are mainly utilized to achieve the transferring of the toner image. Thus, in the secondary toner image transferring operation, the transferring of the toner image is not affected by atmospheric conditions. That is, both the primary and secondary toner image transferring operation are stable independently of atmospheric conditions, and the toner image can be transferred onto the recording sheet with high accuracy.

Fig. 7 is a perspective view, with parts cut away, showing a pressure roll 8 in a printer, which is another embodiment of the invention. The embodiment is substantially the same as the first embodiment except for the secondary toner image transferring operation.

As shown in Fig. 7, the pressurizing roll 8 is in the form of a cylinder, and it accommodates a heat source 80 such as a ceramic heater or halogen lamp, to operate also as heat roll. In transferring a toner image, electrostatic energy, pressure and heat are applied at the same time, so that the toner image is fixed to the recording sheet. When the toner image is heated, the toner resin component is molten, as a result of which the mold release characteristic is improved; that is, the toner image is removed from the elastic layer 51 more readily; while, at the contact region of the recording sheet and the toner image, the gaps between fibers of the recording sheet are filled with the molten toner by pressure. That is, the image transferring operation and the image fixing operation are achieved simultaneously, and therefore the fixing unit may be eliminated. As the elastic layer 51 is heated, the solvent absorbed by the elastic layer in the primary toner image transferring operation is evaporated.

In the case where the pressurizing roll 8 is used as a heating roll as was described above, it is preferable that the elastic layer 51 of the intermediate transferring drum 5 is a heat-resisting layer. As was described before, in order to perform the primary and secondary toner image transferring operations satisfactorily, silicone rubber is used for fabrication of the elastic layer or silicone coating is applied. This is suitable for ensuring the heat resistance of the elastic layer 51.

In the above-described embodiments, the intermediate transferring drum is in the form of a cylinder. However, it may be in the form of an endless belt. In this case also, in the primary toner image transferring operation, transferring the toner image is achieved mainly by the electrostatic energy, and in the secondary toner image transferring operation, a mechanical force is mainly employed. Furthermore, when the belt-shaped intermediate transferring medium and a pressurizing roll which functions also as a heating roller are used in combination, then transferring and fixing the toner image can be achieved simultaneously.

Fig. 8 shows an electrophotographic printer, which is another embodiment of invention. This embodiment is different from the first and second embodiments in that there is provided a toner electric charge removing device 14 in Fig. 8. In the embodiment, the toner image formed on the photosensitive drum is first transferred onto an intermediate transferring drum, and the toner image thus formed on the intermediate transferring drum is then secondly transferred onto a recording sheet while the intermediate transferring drum is abutted against the recording sheet, which is the same manner as the first and second embodiments as described above.

Fig. 9 is a diagram showing reduction of the potential of the toner image on the intermediate transferring drum. The AC corotron 14 is so designed that a tungsten wire 80 0.05 mm in diameter is shielded with a housing 81 in such a manner that the housing 81 is spaced 5 mm from the tungsten wire 80. A voltage of an AC voltage peak to peak 8-9 KV with a frequency of 500 Hz - 1 KHz superimposed on a DC voltage 0 - +300 V is applied to the tungsten wire. The AC corotron is so positioned that it is spaced 1 to 3 mm from the intermediate transferring drum 5.

In Fig. 9, the toner transferred onto the intermediate transferring drum 5 sticks to the elastic layer 51 to form a capacitor, thus providing a potential difference with respect to the intermediate transferring drum. As a result, the toner is stuck to the intermediate transferring drum in an electrostatic mode. In this case, application of positive and negative ions 84 to the toner image, can reduce the electrostatic sticking force acting between the toner 83 and the intermediate transferring drum 5.

In transferring the toner image from the intermediate transferring drum 5 onto the recording sheet 9, the pressurizing roll 8 is pushed against the intermediate transferring drum 5 through the recording sheet 9, so that the elastic layer 51 is deformed in correspondence to the fine unevenness of the recording sheet surface. As a result, the toner image is transferred onto the recording sheet 9 with high fidelity, independently of the smoothness of the recording sheet 9. In this operation, the toner image on the intermediate transferring drum 5 is not so affected by the electrostatic sticking force, and therefore the mechanical elastic

force and mold release characteristic of the elastic layer 51 allows the toner image to be transferred onto the recording sheet 9 with high fidelity. The toner electric charge removing device is effective in any case where the surface of the elastic layer of the intermediate transferring drum is electrically conductive, or insulative. Particularly, in the case where the elastic layer is insulative, not only the electric charge of the toner, but also the electric charge on the elastic layer can be removed by the toner electric charge removing device.

Fig. 10 is a sectional view showing the arrangement of a printer, another embodiment of the invention. This embodiment is different in arrangement from other embodiments only in that mold releasing agent applying unit 20 is so positioned as to apply a mold releasing agent to the intermediate transferring drum 5 before the toner image is transferred from the photo- sensitive drum 1 onto the intermediate transferring drum 5 from which the toner has been removed by the cleaning unit 6. In the embodiment, the mold releasing agent is silicone oil. The mold releasing agent applying unit 20 is a silicone oil impregnated pad. The pad is pushed against the intermediate transferring drum 5 to apply silicone oil to a thickness of the order of submicrons. The toner image is transferred from the photo-sensitive drum 1 onto the intermediate transferring drum 5 which has been coated with silicone oil. Thereafter, the potential of the toner image on the intermediate transferring drum 5 is reduced by the DC corotron 14 and then the toner image is transferred onto the recording sheet 9. In this case, owing to the mold releasing agent, silicone oil, applied to the intermediate transferring drum, the secondary toner image transferring operation is achieved with ease. In addition, the provision of the mold releasing agent applying unit 20 makes it possible to use an elastic material such as urethane rubber low in mold releasing characteristic to form the intermediate transferring drum.

In the above-described embodiment, the intermediate transferring medium is in the form of a drum; however, it goes without saying that it may be in the form of an endless belt.

As was described above, in the wet type image forming apparatus of the invention, the toner image transferred onto the intermediate transferring roller is further transferred onto the recording sheet which is pushed against the intermediate transferring roller. Therefore, the toner image is transferred satisfactorily onto the recording sheet independently of the surface roughness of the latter.

Furthermore, in the invention, the intermediate transferring medium is made up of the elastic layer, which is formed of the electrically conductive rubber having a smooth surface, or which comprises the electrically conductive rubber layer and the relatively thin dielectric layer having a smooth surface. Therefore, with a relatively low transferring voltage, the toner image formed on the electrostatic latent image bearer can be electrostatically transferred onto the intermediate transferring medium with high fidelity, and then the toner image on the intermediate transferring medium can be brought into close contact with the recording sheet which is uneven. That is, the toner image can be satisfactorily transferring onto the recording sheet independently of the surface roughness of the latter.

In the secondary toner image transferring operation, the recording sheet is conveyed while being kept in close contact with the intermediate transferring medium; that is, the recording sheet is conveyed with no slip with respect to the intermediate transferring drum. Therefore, the image forming apparatus of the invention is free from the difficulty that the printed image is low in picture quality because of the irregular conveyance of the recording sheet.

Furthermore, the toner image transferring operation is stably carried out independently of atmospheric conditions such as temperature and humidity. By using the pressurizing roll incorporating a heat source, the transferring operation and the fixing operation can be achieved simultaneously, so that the fixing unit can be eliminated.

In the invention, the intermediate transferring medium is made up of the elastic layer which has a smooth surface and is able to absorb the solvent of the liquid-phase toner. Therefore, after the toner image has been electrostatically transferred onto the intermediate transferring medium with high fidelity, the toner image on the intermediate transferring medium can be brought into close contact with the recording sheet which is uneven. Thus, the toner image can be completely transferred onto the recording sheet; that is, the resultant image formed on the recording sheet is excellent in picture quality.

Furthermore, as was described above, in the wet type image forming apparatus of the invention, the means for reducing the potential of the toner image transferred onto the intermediate transferring medium is provided; that is, the electrostatic sticking force of the toner image to the intermediate transferring medium can be reduced, whereby the transferring of the toner image onto the recording sheet is readily achieved by the mechanical elastic force and mold release characteristic of the intermediate transferring medium. In addition, employment of the intermediate transferring medium which is made up of the elastic layer whose surface is smooth, the toner image is completely transferred onto the intermediate transferring medium in the primary toner image transferring operation, and in the secondary toner image transferring

operation the image is printed excellent in picture quality on the recording sheet. Where the intermediate transferring medium is provided with the mold releasing agent applying means, the toner image transferred onto the intermediate transferring medium is more readily transferred onto the recording sheet. and in addition the intermediate transferring medium can be fabricated by using an elastic material lower in mold releasing characteristic.

Summing up, the invention provides,according to a first aspect,
a wet type image forming apparatus in which an image is formed onto a recording medium, said apparatus comprising:
an image bearer on which an electrostatic latent image is developed into a toner image with liquid-phase toner;
an intermediate transferring medium onto which said toner image is transferred from said image bearer;
first toner image transferring means for electrostatically transferring said toner image developed on said image bearer onto said intermediate transferring medium; and
second toner image transferring means which abuts a recording sheet against said intermediate transferring medium for transferring said toner image from said intermediate transferring medium onto said recording sheet.

According to a second aspect, a wet type image forming apparatus is provided, comprising:
an electrostatic latent image bearer on which an electrostatic latent image is developed into a toner image with liquid-phase toner;
an intermediate transferring medium made up of an elastic layer onto which said toner image is transferred from said electrostatic latent image bearer; and
a pressurizing roll for bringing said recording sheet into close contact with said intermediate transferring medium to transfer said toner image from said intermediate transferring medium onto said recording sheet.

In this apparatus said elastic layer may comprise an electrically conductive layer with a smooth surface or a thin dielectric layer whose surface is smooth and an electrically conductive layer supporting said thin dielectric layer. Said pressurizing roll may further incorporate a heat source. Advantageously, said intermediate transferring medium is made up of an elastic layer which has a smooth surface and absorbs the solvent of said liquid toner, and/or said pressurizing roll incorporates a heat source.

According to a further aspect, the wet type image forming apparatus comprises an image bearer on which a latent image is developed into a toner image with liquid toner;
an intermediate transferring medium onto which said toner image is transferred;
a pressurizing roll which abuts a recording sheet against said intermediate transferring medium for transfering said toner image onto said recording sheet; and
means for reducing the potential of said toner image transferred onto said intermediate transferring medium.

The apparatus may further comprise mold releasing agent applying means for applying a mold releasing agent to said intermediate transferring medium before said toner image is transferred from said image bearer onto said intermediate transferring medium.

While there has been described in connection with the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is aimed, therefore, to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

Claims

1. A wet type image forming apparatus, comprising:
an image bearer (1) on which an electrostatic latent image is developed into a toner image with liquid-phase toner;
an intermediate transferring medium (5) onto which said toner image is transferred from said electrostatic latent image bearer (1); and
means (8) for transferring said toner image from said intermediate transferring medium (5) onto a recording medium (9).

2. The wet type image forming apparatus of claim 1 in which the image transferring side of said intermediate transferring means (5) is elastic.

3. The wet type image forming apparatus of one of the preceding claims in which an image is formed onto a recording medium (9), said appartus comprising:
an image bearer (1) on which an electrostatic latent image is developed into a toner image with liquid-phase toner;
an intermediate transferring medium (5) onto which said toner image is transferred from said image bearer (1);
first toner image transferring means for electrostatically transferring said toner image developed on said image bearer onto said intermediate transferring medium; and
second toner image transferring means (8) which abuts a recording sheet (9) against said intermedi-

ate transferring medium (5) for transferring said toner image from said intermediate transferring medium (5) onto said recording sheet (9).

4. The wet type image forming apparatus of one of the preceding claims, comprising:
an electrostatic latent image bearer (1) on which an electrostatic latent image is developed into a toner image with liquid-phase toner;
an intermediate transferring medium (5) made up of an elastic layer (51) onto which said toner image is transferred from said electrostatic latent image bearer (1); and
a pressurizing roll (8) for bringing said recording sheet (9) into close contact with said intermediate transferring medium (5) to transfer said toner image from said intermediate transferring medium (5) onto said recording sheet (9).

5. The apparatus as claimed in one of claims 2 to 4, in which said elastic layer (51) comprises an electrically conductive layer (53) with a smooth surface.

6. The apparatus as claimed in one of claims 2 to 5, in which said elastic layer (51) comprises a thin dielectric layer (52) whose surface is smooth and an electrically conductive layer (53) supporting said thin dielectric layer (52).

7. The apparatus as claimed in one of the preceding claims, in which said means (8) for transferring the toner image to a recording medium (9) incorporates a heat source (80).

8. The apparatus as claimed in one of the preceding claims, in which said intermediate transferring medium is made up of an elastic layer which has a smooth surface and absorbs the solvent of said liquid toner.

9. The wet type image forming apparatus of one of the preceding claims, further comprising means for reducing the potential of said toner image transferred onto said intermediate transferring medium.

10. The apparatus as claimed in one of the preceding claims, further comprising mold releasing agent applying means (20) for applying a mold releasing agent to said intermediate transferring medium (5) before said toner image is transferred from said image bearer (1) onto said intermediate transferring medium (5).

FIG. 1

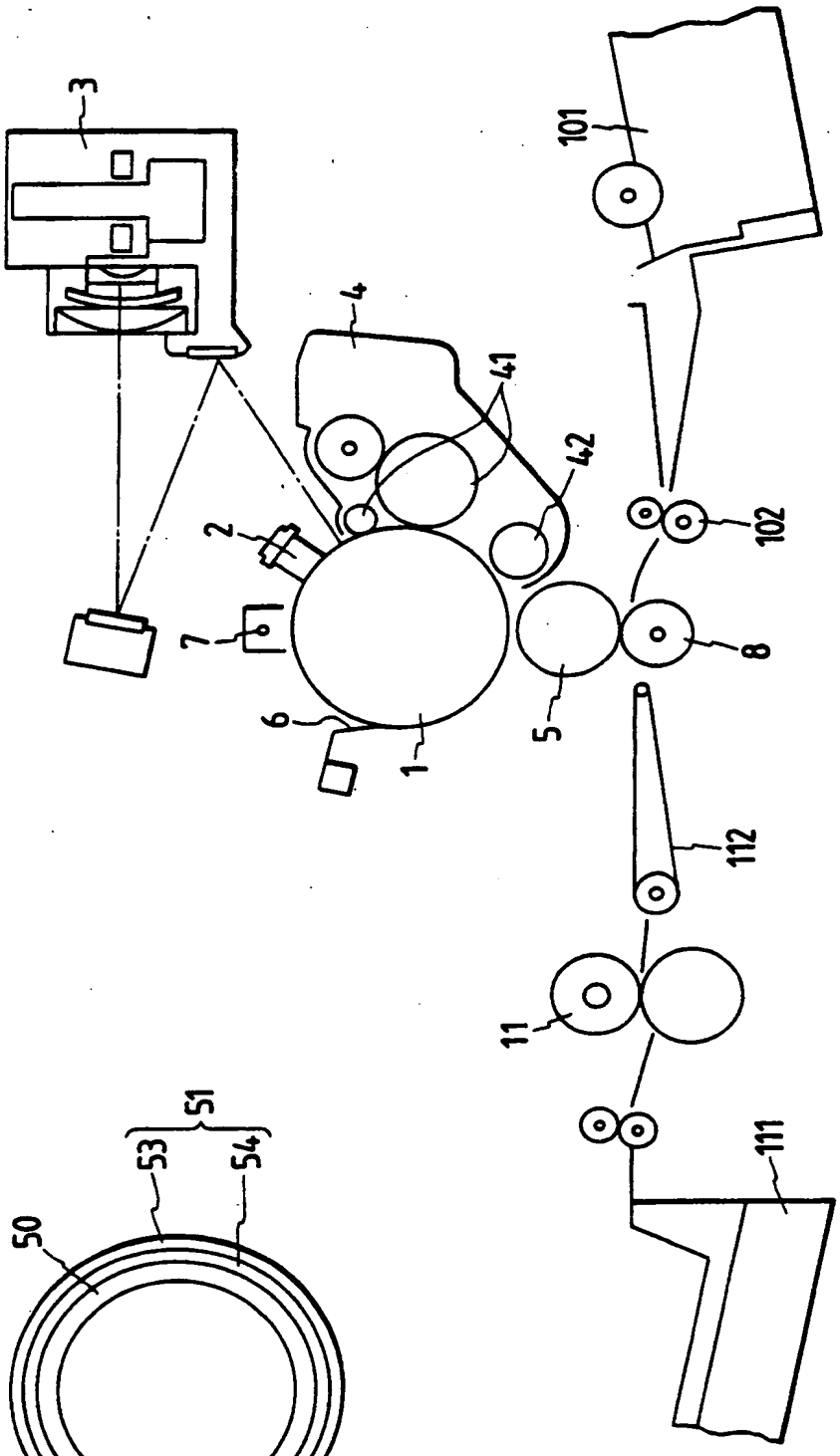


FIG. 2

FIG. 3

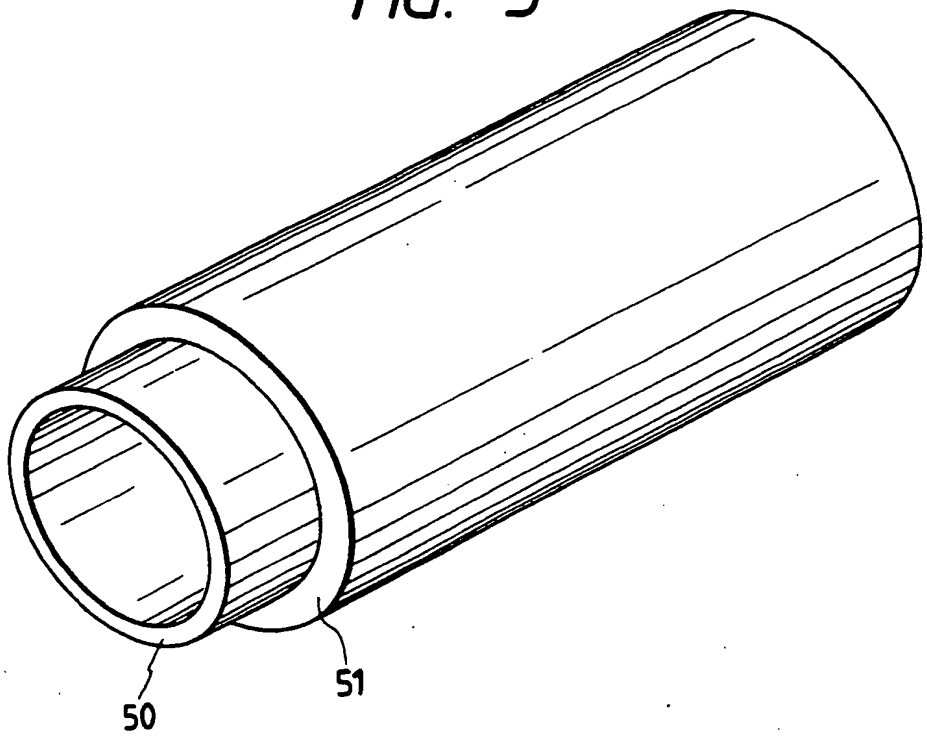


FIG. 4

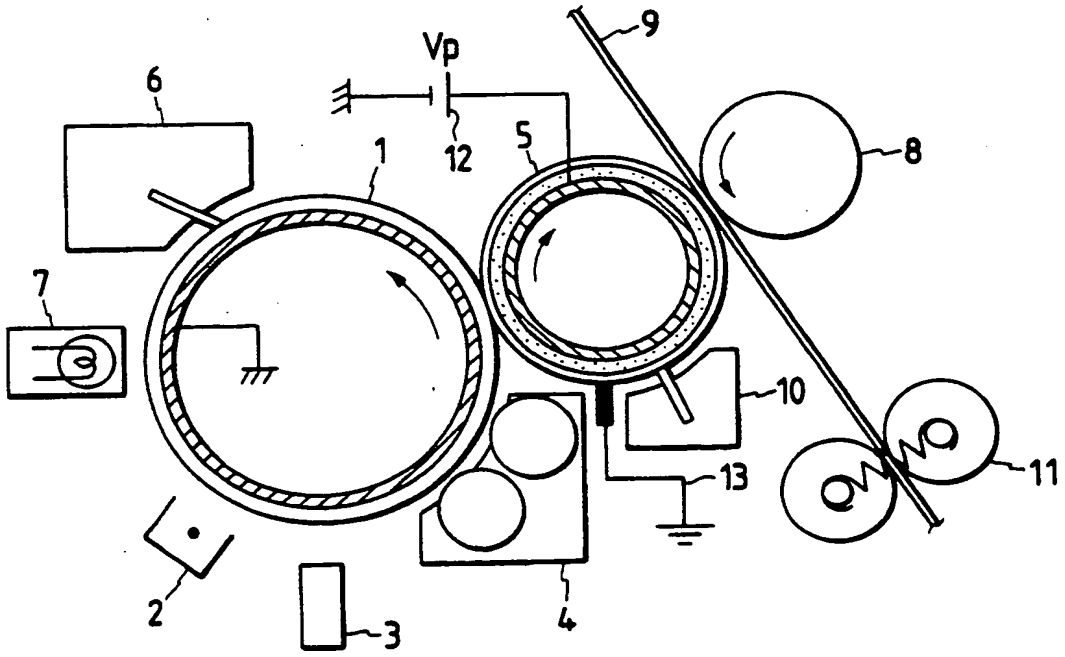


FIG. 5

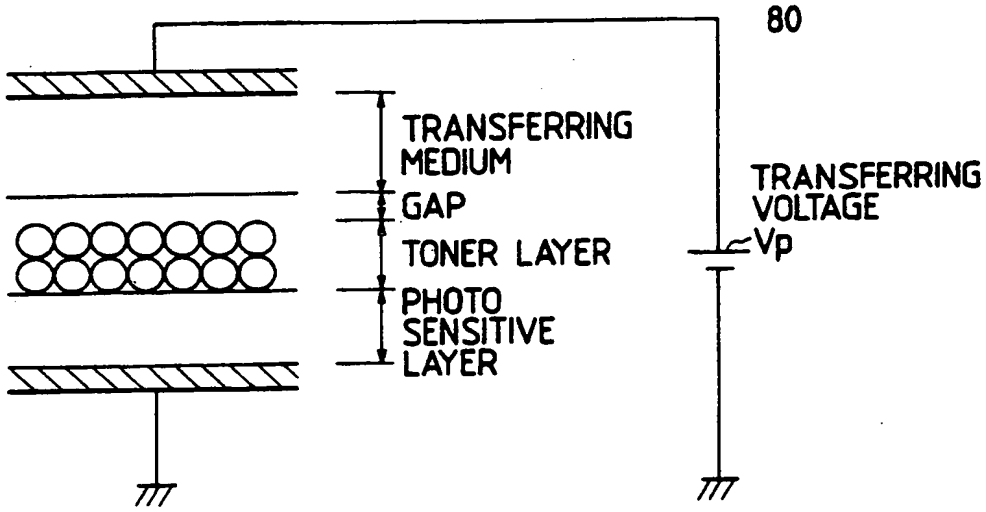

80
TRANSFERRING MEDIUM
GAP
TONER LAYER
PHOTO SENSITIVE LAYER
TRANSFERRING VOLTAGE
Vp

FIG. 6

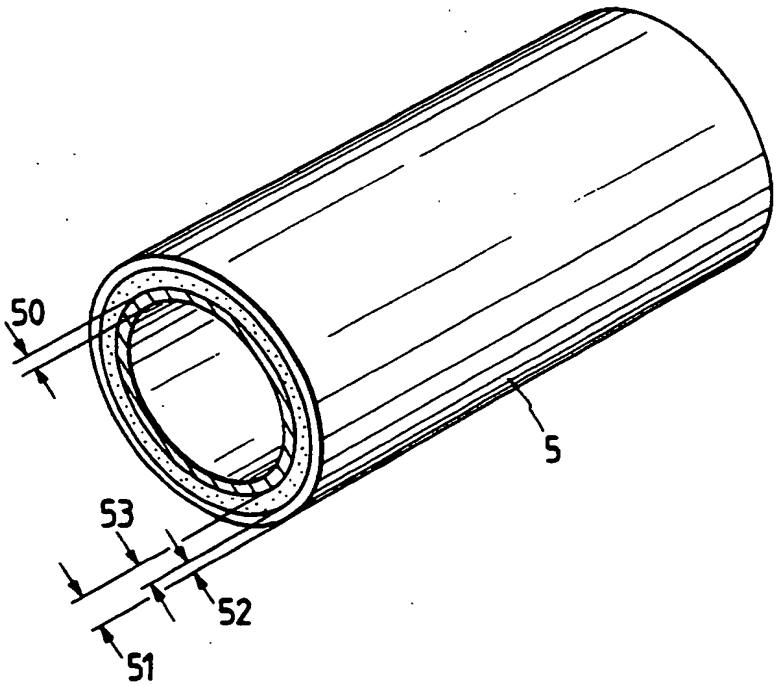

50
5
53
52
51

FIG. 7

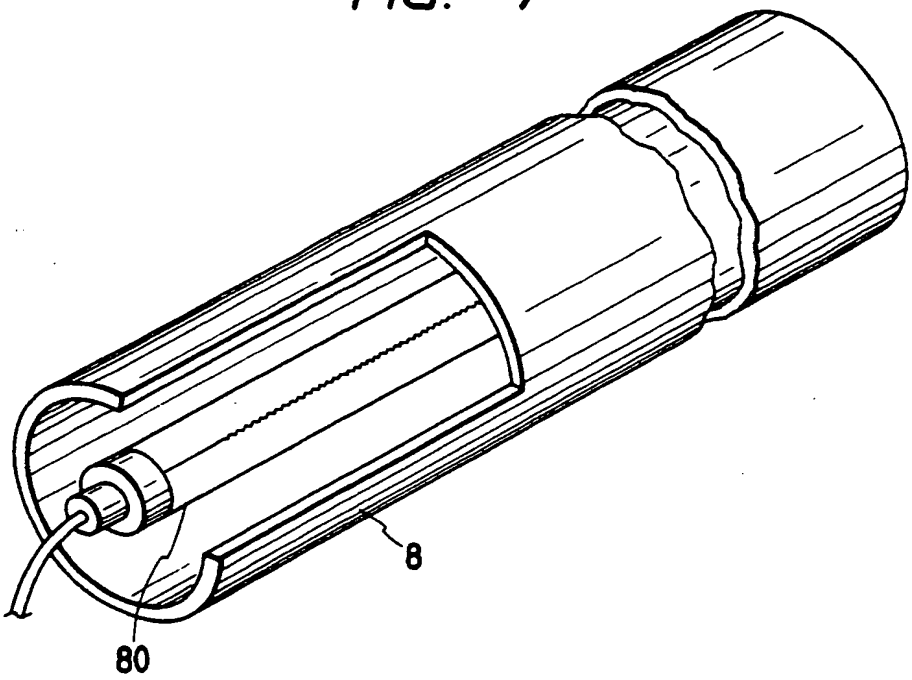


FIG. 8

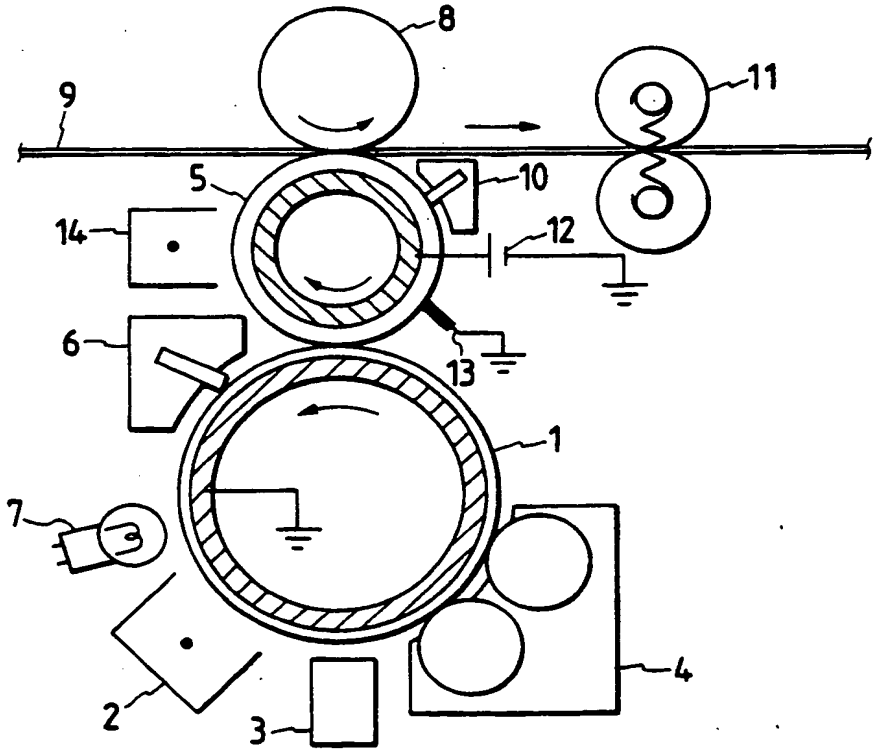


FIG. 9

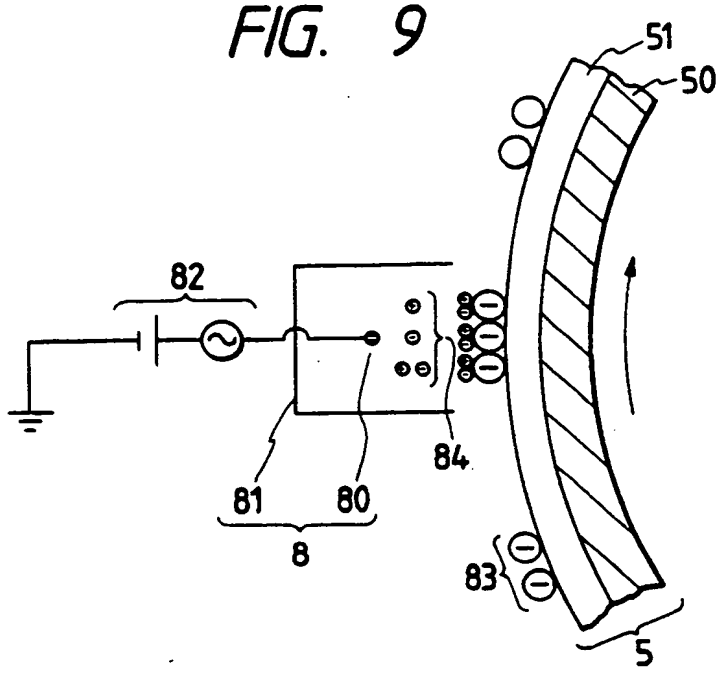
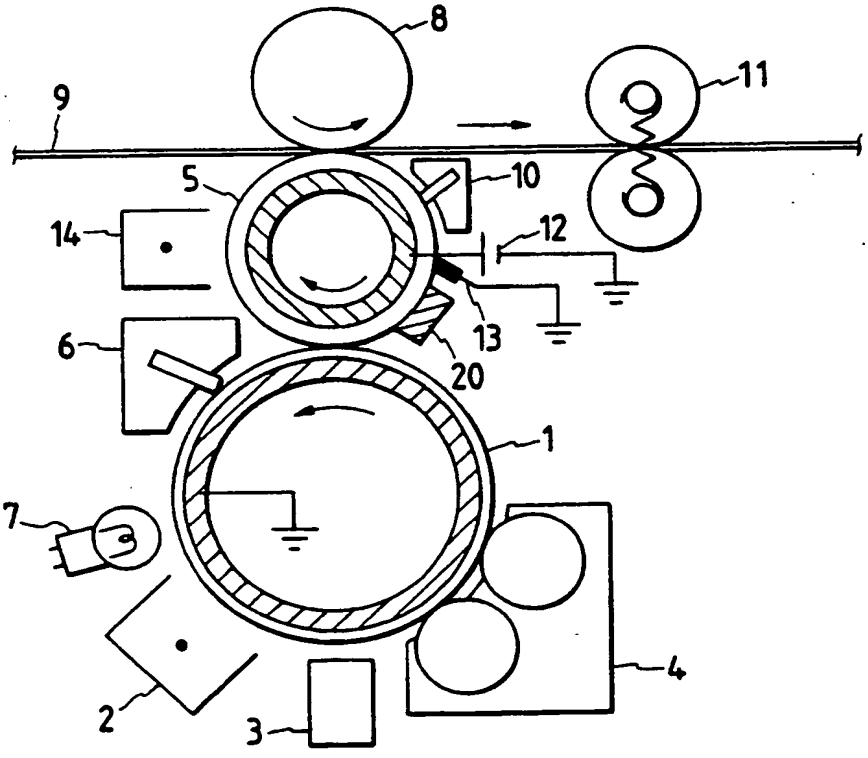


FIG. 10



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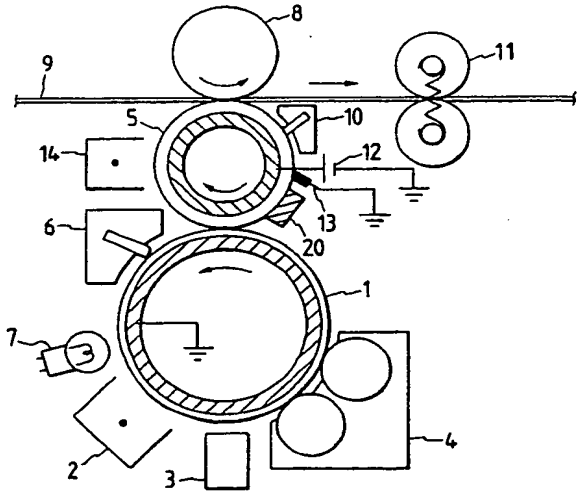
(54) Wet type image forming apparatus.

(57) A wet type image forming apparatus comprises: a photo-sensitive drum (1) on which a latent image is formed and developed into a toner image with liquid-phase toner; an intermediate transferring medium (5) onto which the toner image is transferred; a pressurizing roll (8) which abuts a recording sheet (9) against the intermediate transferring medium (5) to transfer the toner image onto the recording sheet; means for reducing the potential of the toner image transferred onto the intermediate transferring medium; and means (20) for applying a mold releasing agent to the intermediate transferring medium (5) before the toner image is transferred from the image bearer (1) onto the intermediate transferring medium (5), whereby an image high in picture quality can be printed on a recording sheet (9) independently of the smoothness of the recording sheet, and transferring of the toner image can be achieved with low transferring voltage.

FIG. 10



EP 0 399 186 A3

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Application Number

EP 90 10 6434

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
E	WO-A-9 008 984 (SPECTRUM SCIENCES) * complete document *	1-10	G 03 G 15/16 G 03 G 15/10
X	US-A-4 007 041 (C.C. CHOW) * complete document *	1,10	
A		2-9	
X	US-A-4 796 048 (L.F. BEAN) * figures 1-3 *	1	
A	DE-A-3 120 484 (KONISHIROKU PHOTO IND.) * complete document *	1-10	
A	US-A-4 341 455 (R.C. FEDDER) * complete document *	1-10	
A	DE-B-2 152 466 (MINNESOTA MINING AND MANUFACTURING CO.) * claims 1-6; figure *	1-4	
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 238 (P-726)(3085), 7 July 1988; & JP - A - 6329774 (CANON) 08.02.1988	1,8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 03 G 13/00
G 03 G 15/00

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
Berlin	26 June 91	HOPPE H

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